

What is claimed is:

1. A recombinant pox virus comprising a DNA sequence encoding an immunogenic mini-MUC1 fragment comprising approximately 5 to 25 MUC1 tandem repeat units.
2. The recombinant pox virus of claim 1, wherein the immunogenic MUC1 fragment comprises approximately 7 to 15 MUC1 tandem repeat units.
3. The recombinant pox virus of claim 2, wherein the immunogenic MUC1 fragment comprises 10 MUC1 tandem repeat units.
4. The recombinant pox virus of claim 1, wherein the pox virus is selected from the group consisting of orthopox, suipox and avipox.
5. A pharmaceutical composition comprising:
(1) a recombinant pox virus comprising a DNA sequence encoding an immunogenic mini-MUC1 fragment comprising approximately 5 to 25 MUC1 tandem repeat units, and an immunomodulator.
6. The pharmaceutical composition of claim 5, wherein the immunomodulator is selected from the group consisting of T-cell co-stimulatory factors and cytokines.
7. The pharmaceutical composition of claim 6, wherein the immunomodulator is a cytokine and said cytokine is an interleukin.
8. The pharmaceutical composition of claim 6, wherein the immunomodulator is a T-cell co-stimulatory factor.

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9. The pharmaceutical composition of claim 5, wherein the immunomodulator is both a T-cell co-stimulatory factor and a cytokine.

10. The pharmaceutical composition of claim 5, wherein the immunomodulator is encoded on a separate viral vector from said recombinant pox vector comprising DNA encoding an immunogenic mini-MUC1 fragment.

11. The pharmaceutical composition of claim 5, wherein the immunomodulator and the immunogenic mini-MUC fragment are encoded on a single viral vector.

12. The pharmaceutical composition of claim 5, wherein said mini-MUC1 fragment comprises about 7 to 15 tandem repeat units.

13. A method of generating an immune response in a mammal having a tumor expressing MUC1 comprising:

- (a) administering to the mammal an immunizing amount of the pox virus of claim 1,
- (b) at a set interval thereafter boosting by administering a second amount of the miniMUC.

14. The method of claim 13 wherein the boost by an effective amount of miniMUC is administered by an effective amount of second recombinant pox virus having a DNA sequence encoding said immunogenic mini-MUC1 fragment, wherein said second recombinant pox vector is of the same or a different genus from said pox vector of claim 1.

15. The method of claim 13, wherein said mammal is also administered an immunomodulatory compound.

16. The recombinant pox virus of claim 1 which is rV-MUC1.

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17. The method of claim 13 wherein the boost by an effective amount of miniMUC is administered by a miniMUC protein peptide or by a DNA segment encoding said miniMUC protein.

18. The method of claim 17 wherein said DNA segment is administered as naked DNA, by gene gun or by a viral vector other than a pox viral vector.

19. A method of inhibiting or killing MUC1 positive tumor cells comprising:

(a) generating MUC1 specific cytotoxic T-lymphocytes in vitro by stimulation of lymphocytes from a source by administration of an effective amount of a MUC1 specific antigen, alone or in combination with one or more cytokines to generate said MUC1 specific cytotoxic T lymphocytes, and

(b) adoptively transferring the MUC1 specific cytotoxic T lymphocytes alone or in combination with boosting agents into a mammal in an amount sufficient to inhibit or kill the MUC1 positive tumor cells.

20. A kit containing the pharmaceutical composition of claim 5, and instructions for its use.

21. The kit of claim 21 further containing an adjuvant.

22. A method of generating an immune response in a mammal having a tumor expressing MUC1 comprising:

(a) administering to the mammal an immunizing amount of a viral vector other than a pox-virus vector expressing mini-MUC1 or administering a DNA segment encoding mini-MUC; and

(b) at a set interval thereafter boosting by administering a pox virus of claim 1.

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